

	Type	L #	Hits	Search Text	DBs	Time Stamp	Comments	Error Definition	Errors
1	BRS	L1	30966	por\$5 near5 silicon	USPAT; US-PGPUB	2003/04/03 09:48			0
2	IS&R	L2	2	((("4651406") or ("4471373")).PN.	USPAT; US-PGPUB	2003/04/03 09:49			0
3	BRS	L3	2	1 and 2	USPAT; US-PGPUB	2003/04/03 09:49			0
4	BRS	L4	386	(non-porous\$2 or (non adj porous\$2)) near5 silicon	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/03 11:12			0
5	BRS	L5	6939	porous\$2 near5 silicon	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/03 11:13			0
6	BRS	L6	379	4 and 5	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/03 11:13			0
7	BRS	L7	1026	(oxidiz\$8 or oxidaz\$8) with 5	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/03 11:15			0
8	BRS	L8	110	6 and 7	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/03 11:15			0
9	BRS	L9	18039	(thick\$3 near10 (oxide\$1 or dioxide\$1)) and (thin\$4 near10 (oxide\$1 or dioxide\$1))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/03 12:36			0

	Type	L #	Hits	Search Text	DBs	Time Stamp	Comments	Error Definition	Errors
10	BRS	L10	125825	(multiple or difference\$3 or various or vary or varies or varying or two or second or another) near8 (oxide\$1 or dioxide\$1)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/03 12:38			0
11	BRS	L11	44106	(first near8 (oxide\$1 or dioxide\$1)) and ((second or another) near8 (oxide\$1 or dioxide\$1))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/03 12:39			0
12	BRS	L12	3816	(first near8 (oxide\$1 or dioxide\$1)) with ((second or another) near8 (oxide\$1 or dioxide\$1)) with (thicker or thinner or thinner or greater or smaller or less or bigger or more)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/03 12:42			0
13	BRS	L13	6990	(oxide\$1 or dioxide\$1) with (varying or variable or varies or vary or difference\$4 or multiple) with (thickness\$2 or thick-ness\$2 or (thick adj ness))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/03 12:42			0
14	BRS	L14	2122	first with second with (thickness\$2 or thick-ness\$2 or (thick adj ness\$2)) with (oxide\$1 or dioxide\$1) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/03 12:46			0

	Type	L #	Hits	Search Text	Dbs	Time Stamp	Comments	Error Definition	Errorors
15	BRS	L15	134593	9 or 10 or 11 or 12 or 13 or 14	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/03 12:47			0
16	BRS	L16	47	8 and 15	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/03 12:47			0
17	BRS	L17	0	6013557.URPN.	USPAT	2003/04/03 13:37			0
18	BRS	L18	18	("3640806" "3919060" "3962052" "4016017" "4096619" "4180416" "4748134" "4764248" "5156896" "5159428" "5260229" "5294563" "5298451" "5358894" "5369051" "5376560" "5707888" "5712186").PN.	USPAT	2003/04/03 13:38		0	

	Type	L #	Hits	Search Text	DBs	Time Stamp	Comments	Error Definition	Errors
1	BRS	L1	30966	por\$5 near\$5 silicon	USPAT; US-PGPUB	2003/04/03 09:48			0
2	IS&R	L2	2	((("4651406") or ("4471373")).PN.	USPAT; US-PGPUB	2003/04/03 09:49			0
3	BRS	L3	2	1 and 2	USPAT; US-PGPUB	2003/04/03 09:49			0
4	BRS	L4	386	(non-porous\$2 or (non adj porous\$2)) near\$5 silicon	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/03 11:12			0
5	BRS	L5	6939	porous\$2 near\$5 silicon	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/03 11:13			0
6	BRS	L6	379	4 and 5	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/03 11:13			0
7	BRS	L7	1026	(oxidiz\$8 or oxida\$8) with 5	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/03 11:15			0
8	BRS	L8	110	6 and 7	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/03 11:15			0
9	BRS	L9	18039	(thick\$3 near\$10 (oxide\$1 or dioxide\$1)) and (thin\$4 near\$10 (oxide\$1 or dioxide\$1))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/03 12:36			0

	Type	L #	Hits	Search Text	Dbs	Time Stamp	Comments	Error Definition	Errors
10	BRS	L10	125825	(multiple or differen\$3 or various or vary or varies or varying or two or second or another) near8 (oxide\$1 or dioxide\$1)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/03 12:38			0
11	BRS	L11	44106	(first near8 (oxide\$1 or dioxide\$1)) and ((second or another) near8 (oxide\$1 or dioxide\$1))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/03 12:39			0
12	BRS	L12	3816	(first near8 (oxide\$1 or dioxide\$1)) with ((second or another) near8 (oxide\$1 or dioxide\$1)) with (thicker or thinner or thinner or greater or smaller or less or bigger or more)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/03 12:42			0
13	BRS	L13	6990	(oxide\$1 or dioxide\$1) with (varying or variable or varies or vary or differen\$4 or multiple) with (thickness\$2 or thick-ness\$2 or (thick adj ness))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/03 12:42			0
14	BRS	L14	2122	first with second with (thickness\$2 or thick-ness\$2 or (thick adj ness\$2)) with (oxide\$1 or dioxide\$1) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/04/03 12:46			0

	Type	L #	Hits	Search Text	Dbs	Time Stamp	Comments	Error Definition	Errors
15	BRS	L15	134593	9 or 10 or 11 or 12 or 13 or 14	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB	2003/04/03 12:47			0
16	BRS	L16	47	8 and 15	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB	2003/04/03 12:47			0

L Number	Hits	Search Text	DB	Time stamp
-	0	(substrate\$1 or wafer\$1) with (HF or "HF" or (hydrogen adj fluoride) or hydrofluor\$4) with oxidant\$1 with (solvent\$1 or alcohol\$1 or glycol\$1 or non-protic\$1 or (non adj protic\$1))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 15:35
-	0	(substrate\$1 or wafer\$1) with (HF or "HF" or (hydrogen adj fluoride) or hydrofluor\$4 or hydro-fluor\$4) with oxidant\$1 with (solvent\$1 or alcohol\$1 or glycol\$1 or non-protic\$1 or (non adj protic\$1))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 12:34
-	1	(substrate\$1 or wafer\$1) same (HF or "HF" or (hydrogen adj fluoride) or hydrofluor\$4 or hydro-fluor\$4) same oxidant\$1 same (solvent\$1 or alcohol\$1 or glycol\$1 or non-protic\$1 or (non adj protic\$1))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 13:59
-	86	(convert\$3 or chang\$3 or adapt\$3 or alter\$3 or renovat\$3 or switch\$3 or translat\$3) with (non-porous\$2 or (non adj porous\$2)) with porous\$2 with (silicon or wafer\$1 or substrate)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 17:49
-	151723	(wafer\$1 or substrate\$1) with (photoresist\$3 or photo-resist\$3 or (photo adj resist\$3) or PR or resist\$3)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 12:48
-	22	((convert\$3 or chang\$3 or adapt\$3 or alter\$3 or renovat\$3 or switch\$3 or translat\$3) with (non-porous\$2 or (non adj porous\$2)) with porous\$2 with (silicon or wafer\$1 or substrate)) and ((wafer\$1 or substrate\$1) with (photoresist\$3 or photo-resist\$3 or (photo adj resist\$3) or PR or resist\$3))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 12:50
-	15390	(oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 17:35
-	0	((convert\$3 or chang\$3 or adapt\$3 or alter\$3 or renovat\$3 or switch\$3 or translat\$3) with (non-porous\$2 or (non adj porous\$2)) with porous\$2 with (silicon or wafer\$1 or substrate)) and ((wafer\$1 or substrate\$1) with (photoresist\$3 or photo-resist\$3 or (photo adj resist\$3) or PR or resist\$3)) and ((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 12:54
-	2	((convert\$3 or chang\$3 or adapt\$3 or alter\$3 or renovat\$3 or switch\$3 or translat\$3) with (non-porous\$2 or (non adj porous\$2)) with porous\$2 with (silicon or wafer\$1 or substrate)) and ((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 12:55
-	5618	first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 17:36
-	306	(convert\$3 or chang\$3 or adapt\$3 or alter\$3 or renovat\$3 or switch\$3 or translat\$3) same (non-porous\$2 or (non adj porous\$2)) same porous\$2 same (silicon or wafer\$1 or substrate)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 13:49

-	61253	(oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (substrate\$1 or wafer\$1)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 14:22
-	19701	((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 13:53
-	9	((convert\$3 or chang\$3 or adapt\$3 or alter\$3 or renovat\$3 or switch\$3 or translat\$3) same (non-porous\$2 or (non adj porous\$2)) same porous\$2 same (silicon or wafer\$1 or substrate)) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (substrate\$1 or wafer\$1)) and (((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger)))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 13:54
-	6	((convert\$3 or chang\$3 or adapt\$3 or alter\$3 or renovat\$3 or switch\$3 or translat\$3) same (non-porous\$2 or (non adj porous\$2)) same porous\$2 same (silicon or wafer\$1 or substrate)) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (substrate\$1 or wafer\$1)) and (((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger)))) and ((wafer\$1 or substrate\$1) with (photoresist\$3 or photo-resist\$3 or (photo adj resist\$3) or PR or resist\$3))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 13:55
-	271	(substrate\$1 or wafer\$1) same (HF or "HF" or (hydrogen adj fluoride) or hydrofluor\$4 or hydro-fluor\$4) same (current\$3 or amp\$1 or milli-amp\$1 or (milli adj amp\$1)) same (immers\$4 or dip\$4 or submerg\$4)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 14:49

-	0	(((convert\$3 or chang\$3 or adapt\$3 or alter\$3 or renovat\$3 or switch\$3 or translat\$3) same (non-porous\$2 or (non adj porous\$2)) same porous\$2 same (silicon or wafer\$1 or substrate)) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (substrate\$1 or wafer\$1)) and (((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger)))) and ((wafer\$1 or substrate\$1) with (photoresist\$3 or photo-resist\$3 or (photo adj resist\$3) or PR or resist\$3))) and ((substrate\$1 or wafer\$1) same (HF or "HF" or (hydrogen adj fluoride) or hydrofluor\$4 or hydro-fluor\$4) same (current\$3 or amp\$1 or milli-amp\$1 or (milli adj amp\$1)) same (immers\$4 or dip\$4 or submerg\$4))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 14:04
-	1325	(substrate\$1 or wafer\$1) same (HF or "HF" or (hydrogen adj fluoride) or hydrofluor\$4 or hydro-fluor\$4) same (current\$3 or amp\$1 or milli-amp\$1 or (milli adj amp\$1))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 14:07
-	3	(((convert\$3 or chang\$3 or adapt\$3 or alter\$3 or renovat\$3 or switch\$3 or translat\$3) same (non-porous\$2 or (non adj porous\$2)) same porous\$2 same (silicon or wafer\$1 or substrate)) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (substrate\$1 or wafer\$1)) and (((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger)))) and ((wafer\$1 or substrate\$1) with (photoresist\$3 or photo-resist\$3 or (photo adj resist\$3) or PR or resist\$3))) and ((substrate\$1 or wafer\$1) same (HF or "HF" or (hydrogen adj fluoride) or hydrofluor\$4 or hydro-fluor\$4) same (current\$3 or amp\$1 or milli-amp\$1 or (milli adj amp\$1)))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 14:07
-	5551	(oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (rate or rat\$3) with increas\$4	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 14:40
-	257	(((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger))) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (rate or rat\$3) with increas\$4)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 14:26

-	65	((wafer\$1 or substrate\$1) with (photoresist\$3 or photo-resist\$3 or (photo adj resist\$3) or PR or resist\$3)) and (((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger))) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (rate or rat\$3) with increas\$4)) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (substrate\$1 or wafer\$1))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 14:27
-	8512	(oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (rate or rat\$3) with (increas\$4 or higher or boost\$3 or enlarg\$3 or rais\$3 or enhanc\$3)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 14:42
-	393	((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger))) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (rate or rat\$3) with (increas\$4 or higher or boost\$3 or enlarg\$3 or rais\$3 or enhanc\$3))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 14:44
-	108	((wafer\$1 or substrate\$1) with (photoresist\$3 or photo-resist\$3 or (photo adj resist\$3) or PR or resist\$3)) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (substrate\$1 or wafer\$1)) and (((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger))) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (rate or rat\$3) with (increas\$4 or higher or boost\$3 or enlarg\$3 or rais\$3 or enhanc\$3)))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 14:45
-	2115	(substrate\$1 or wafer\$1) same (solution\$1 or solvent\$1) same (current\$3 or amp\$1 or milli-amp\$1 or (milli adj amp\$1)) same (immers\$4 or dip\$4 or submerg\$4)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 14:51

-	2	((wafer\$1 or substrate\$1) with (photoresist\$3 or photo-resist\$3 or (photo adj resist\$3) or PR or resist\$3)) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (substrate\$1 or wafer\$1)) and (((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger))) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (rate or rat\$3) with (increas\$4 or higher or boost\$3 or enlarg\$3 or rais\$3 or enhanc\$3))) and ((substrate\$1 or wafer\$1) same (solution\$1 or solvent\$1) same (current\$3 or amp\$1 or milli-amp\$1 or (milli adj amp\$1)) same (immers\$4 or dip\$4 or submerg\$4))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 14:52
-	10	(((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger))) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (rate or rat\$3) with (increas\$4 or higher or boost\$3 or enlarg\$3 or rais\$3 or enhanc\$3))) and ((substrate\$1 or wafer\$1) same (solution\$1 or solvent\$1) same (current\$3 or amp\$1 or milli-amp\$1 or (milli adj amp\$1)) same (immers\$4 or dip\$4 or submerg\$4))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 14:53
-	0	((wafer\$1 or substrate\$1) with (photoresist\$3 or photo-resist\$3 or (photo adj resist\$3) or PR or resist\$3)) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (substrate\$1 or wafer\$1)) and (((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger))) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (rate or rat\$3) with (increas\$4 or higher or boost\$3 or enlarg\$3 or rais\$3 or enhanc\$3))) and ((substrate\$1 or wafer\$1) same (HF or "HF" or (hydrogen adj fluoride) or hydrofluor\$4 or hydro-fluor\$4) same oxidant\$1 same (solvent\$1 or alcohol\$1 or glycol\$1 or non-protic\$1 or (non adj protic\$1)))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 14:54

-	0	(((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger))) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (rate or rat\$3) with (increas\$4 or higher or boost\$3 or enlarg\$3 or rais\$3 or enhanc\$3))) and ((substrate\$1 or wafer\$1) same (HF or "HF" or (hydrogen adj fluoride) or hydrofluor\$4 or hydro-fluor\$4) same oxidant\$1 same (solvent\$1 or alcohol\$1 or glycol\$1 or non-protic\$1 or (non adj protic\$1)))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 14:53
-	0	((wafer\$1 or substrate\$1) with (photoresist\$3 or photo-resist\$3 or (photo adj resist\$3) or PR or resist\$3)) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (substrate\$1 or wafer\$1)) and (((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger))) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (rate or rat\$3) with (increas\$4 or higher or boost\$3 or enlarg\$3 or rais\$3 or enhanc\$3))) and ((convert\$3 or chang\$3 or adapt\$3 or alter\$3 or renovat\$3 or switch\$3 or translat\$3) with (non-porous\$2 or (non adj porous\$2)) with porous\$2 with (silicon or wafer\$1 or substrate))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 14:56
-	0	(((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger))) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (rate or rat\$3) with (increas\$4 or higher or boost\$3 or enlarg\$3 or rais\$3 or enhanc\$3))) and ((convert\$3 or chang\$3 or adapt\$3 or alter\$3 or renovat\$3 or switch\$3 or translat\$3) with (non-porous\$2 or (non adj porous\$2)) with porous\$2 with (silicon or wafer\$1 or substrate))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 14:55

-	3	((wafer\$1 or substrate\$1) with (photoresist\$3 or photo-resist\$3 or (photo adj resist\$3) or PR or resist\$3)) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (substrate\$1 or wafer\$1)) and (((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger))) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (rate or rat\$3) with (increas\$4 or higher or boost\$3 or enlarg\$3 or rais\$3 or enhanc\$3))) and ((convert\$3 or chang\$3 or adapt\$3 or alter\$3 or renovat\$3 or switch\$3 or translat\$3) same (non-porous\$2 or (non adj porous\$2)) same porous\$2 same (silicon or wafer\$1 or substrate))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 14:57
-	3	(((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger))) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (rate or rat\$3) with (increas\$4 or higher or boost\$3 or enlarg\$3 or rais\$3 or enhanc\$3))) and ((convert\$3 or chang\$3 or adapt\$3 or alter\$3 or renovat\$3 or switch\$3 or translat\$3) same (non-porous\$2 or (non adj porous\$2)) same porous\$2 same (silicon or wafer\$1 or substrate))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 14:56
-	0	((wafer\$1 or substrate\$1) with (photoresist\$3 or photo-resist\$3 or (photo adj resist\$3) or PR or resist\$3)) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (substrate\$1 or wafer\$1)) and (((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger))) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (rate or rat\$3) with (increas\$4 or higher or boost\$3 or enlarg\$3 or rais\$3 or enhanc\$3))) and ((substrate\$1 or wafer\$1) same (HF or "HF" or (hydrogen adj fluoride) or hydrofluor\$4 or hydro-fluor\$4) same (current\$3 or amp\$1 or milli-amp\$1 or (milli adj amp\$1)) same (immers\$4 or dip\$4 or submerg\$4))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 14:57

-	1	(((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger))) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (rate or rat\$3) with (increas\$4 or higher or boost\$3 or enlarg\$3 or rais\$3 or enhanc\$3))) and ((substrate\$1 or wafer\$1) same (HF or "HF" or (hydrogen adj fluoride) or hydrofluor\$4 or hydro-fluor\$4) same (current\$3 or amp\$1 or milli-amp\$1 or (milli adj amp\$1)) same (immers\$4 or dip\$4 or submerg\$4)))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 14:57
-	3	(((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger))) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (rate or rat\$3) with (increas\$4 or higher or boost\$3 or enlarg\$3 or rais\$3 or enhanc\$3))) and ((substrate\$1 or wafer\$1) same (HF or "HF" or (hydrogen adj fluoride) or hydrofluor\$4 or hydro-fluor\$4) same (current\$3 or amp\$1 or milli-amp\$1 or (milli adj amp\$1)))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 14:58
-	0	((wafer\$1 or substrate\$1) with (photoresist\$3 or photo-resist\$3 or (photo adj resist\$3) or PR or resist\$3)) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (substrate\$1 or wafer\$1)) and (((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger))) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (rate or rat\$3) with (increas\$4 or higher or boost\$3 or enlarg\$3 or rais\$3 or enhanc\$3))) and ((substrate\$1 or wafer\$1) same (HF or "HF" or (hydrogen adj fluoride) or hydrofluor\$4 or hydro-fluor\$4) same (current\$3 or amp\$1 or milli-amp\$1 or (milli adj amp\$1)))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 14:58
-	69932	STI\$1 or (shallow adj trench adj isolat\$4)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 15:19

-	18	((wafer\$1 or substrate\$1) with (photoresist\$3 or photo-resist\$3 or (photo adj resist\$3) or PR or resist\$3)) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (substrate\$1 or wafer\$1)) and (((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger))) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (rate or rat\$3) with (increas\$4 or higher or boost\$3 or enlarg\$3 or rais\$3 or enhanc\$3)))) and (STI\$1 or (shallow adj trench adj isolat\$4))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 15:20
-	5576	(oxide\$1 or dioxide\$1) with porous with (silicon or substrate\$1 or wafer\$1)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 15:22
-	10	((wafer\$1 or substrate\$1) with (photoresist\$3 or photo-resist\$3 or (photo adj resist\$3) or PR or resist\$3)) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (substrate\$1 or wafer\$1)) and (((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger))) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (rate or rat\$3) with (increas\$4 or higher or boost\$3 or enlarg\$3 or rais\$3 or enhanc\$3)))) and ((oxide\$1 or dioxide\$1) with porous with (silicon or substrate\$1 or wafer\$1))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 16:38
-	436	(oxide\$1 or dioxide\$1) with (nonporous or non-porous or (non adj porous)) with (silicon or substrate\$1 or wafer\$1)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 15:23
-	0	((wafer\$1 or substrate\$1) with (photoresist\$3 or photo-resist\$3 or (photo adj resist\$3) or PR or resist\$3)) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (substrate\$1 or wafer\$1)) and (((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger))) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (rate or rat\$3) with (increas\$4 or higher or boost\$3 or enlarg\$3 or rais\$3 or enhanc\$3)))) and ((oxide\$1 or dioxide\$1) with (nonporous or non-porous or (non adj porous)) with (silicon or substrate\$1 or wafer\$1))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 15:24

-	0	((((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger))) and ((oxidation or oxidizing or oxidized or oxidiz\$8 or oxidat\$4) with (rate or rat\$3) with (increas\$4 or higher or boost\$3 or enlarg\$3 or rais\$3 or enhanc\$3))) and ((oxide\$1 or dioxide\$1) with (nonporous or non-porous or (non adj porous)) with (silicon or substrate\$1 or wafer\$1))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2002/08/04 15:24
-	289	(438/981).CCLS.	USPAT; US-PGPUB	2002/08/04 16:40
-	3147	((438/197) or (438/200) or (438/241) or (438/258) or (438/275) or (438/279) or (438/286) or (438/287) or (438/409) or (438/422) or (438/585)).CCLS.	USPAT; US-PGPUB	2002/08/04 16:47
-	547	((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4) with thickness\$2) or (first with second with thickness\$2 with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger))) and ((438/197) or (438/200) or (438/241) or (438/258) or (438/275) or (438/279) or (438/286) or (438/287) or (438/409) or (438/422) or (438/585)).CCLS.)	USPAT; US-PGPUB	2002/08/04 16:48
-	3	("6143669") or ("6091109") or ("6335262").PN.	USPAT; US-PGPUB	2002/08/05 16:24
-	2358	(non-porous\$2 or (non adj porous\$2)) near15 (silicon or wafer\$1 or substrate or semiconductor)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 16:57
-	196701	(porous\$2 or hole\$1 or bubbl\$3 or void\$1 or cavit\$3) near15 (silicon or wafer\$1 or substrate or semiconductor)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 18:09
-	5165	(non-porous\$2 or (non adj porous\$2) or impermeabl\$3) near15 (silicon or wafer\$1 or substrate or semiconductor)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 16:57
-	3109	((porous\$2 or hole\$1 or bubbl\$3 or void\$1 or cavit\$3) near15 (silicon or wafer\$1 or substrate or semiconductor)) and ((non-porous\$2 or (non adj porous\$2) or impermeabl\$3) near15 (silicon or wafer\$1 or substrate or semiconductor))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 16:56
-	385	(non-porous\$2 or (non adj porous\$2)) near5 silicon	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 16:58
-	6924	porous\$2 near5 silicon	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 16:59
-	378	((non-porous\$2 or (non adj porous\$2)) near5 silicon) and (porous\$2 near5 silicon)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 16:59

-	34995	(thick\$3 near10 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$3 or isolat\$3)) and (thin\$4 near10 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$3 or isolat\$3))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 17:03
-	54	((non-porous\$2 or (non adj porous\$2)) near5 silicon) and (porous\$2 near5 silicon)) and ((thick\$3 near10 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$3 or isolat\$3)) and (thin\$4 near10 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$3 or isolat\$3)))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 17:03
-	465504	(multiple or differen\$3 or various or vary or varies or varying or two or second or another) near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 17:29
-	180117	(first near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) and (second near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 17:31
-	180117	(first near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) and ((second or another) near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 17:34
-	15690	(first near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) with ((second or another) near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) with (thicker or thinner or thiner or greater or smaller or less or bigger or more)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 17:37
-	18632	(oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4 or multiple) with (thickness\$2 or thick-ness\$2 or (thick adj ness))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 17:39
-	6307	first with second with (thickness\$2 or thick-ness\$2 or (thick adj ness\$2)) with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 17:41

-	478508	((thick\$3 near10 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$3 or isolat\$3)) and (thin\$4 near10 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$3 or isolat\$3))) or ((multiple or differen\$3 or various or vary or varies or varying or two or second or another) near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) or ((first near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) and (second near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) or ((first near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) and ((second or another) near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4))) or ((first near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) with ((second or another) near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) with (thicker or thinner or thiner or greater or smaller or less or bigger or more)) or ((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4 or multiple) with (thickness\$2 or thick-ness\$2 or (thick adj ness))) or (first with second with (thickness\$2 or thick-ness\$2 or (thick adj ness\$2)) with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 17:47
-	190	(convert\$3 or chang\$3 or produc\$4 or adapt\$3 or alter\$3 or renovat\$3 or switch\$3 or translat\$3 or form\$4) with ((non-porous\$2 or (non adj porous\$2)) near5 silicon) with (porous\$2 near5 silicon)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 18:30

-	82	((thick\$3 near10 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$3 or isolat\$3)) and (thin\$4 near10 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$3 or isolat\$3))) or ((multiple or differen\$3 or various or vary or varies or varying or two or second or another) near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) or ((first near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) and (second near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) or ((first near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) and ((second or another) near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4))) or ((first near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) with ((second or another) near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) with (thicker or thinner or thiner or greater or smaller or less or bigger or more)) or ((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4 or multiple) with (thickness\$2 or thick-ness\$2 or (thick adj ness))) or (first with second with (thickness\$2 or thick-ness\$2 or (thick adj ness\$2)) with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger))) and ((convert\$3 or chang\$3 or produc\$4 or adapt\$3 or alter\$3 or renovat\$3 or switch\$3 or translat\$3 or form\$4) with ((non-porous\$2 or (non adj porous\$2)) near5 silicon) with (porous\$2 near5 silicon))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 17:59
-	610069	(porous\$2 or hole\$1 or bubbl\$3 or void\$1 or cavit\$3 or vacanc\$3 or permeabl\$3) near15 (silicon or wafer\$1 or substrate or semiconductor or material\$1)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 18:13
-	43497	(non-porous\$2 or (non adj porous\$2) or impermeabl\$3 or porous-free or (free near2 porous\$2) or non-hole\$1 or (free near2 hole\$1) or non-bubbl\$3 or (free near2 bubbl\$3) or non-void\$1 or (void near2 free) or non-cavit\$3 or (free near2 cavit\$3) or non-vacanc\$3 or (free near2 vacanc\$3)) near15 (silicon or wafer\$1 or substrate or semiconductor or material\$1)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 18:20
-	8857	(convert\$3 or chang\$3 or produc\$4 or adapt\$3 or alter\$3 or renovat\$3 or switch\$3 or translat\$3 or form\$4) with (non-porous\$2 or (non adj porous\$2) or impermeabl\$3 or porous-free or (free near2 porous\$2) or non-hole\$1 or (free near2 hole\$1) or non-bubbl\$3 or (free near2 bubbl\$3) or non-void\$1 or (void near2 free) or non-cavit\$3 or (free near2 cavit\$3) or non-vacanc\$3 or (free near2 vacanc\$3)) with (silicon or wafer\$1 or substrate or semiconductor or material\$1) with (porous\$2 or hole\$1 or bubbl\$3 or void\$1 or cavit\$3 or vacanc\$3 or permeabl\$3)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 18:27

-	27879	((porous\$2 or hole\$1 or bubbl\$3 or void\$1 or cavit\$3 or vacanc\$3 or permeabl\$3) near15 (silicon or wafer\$1 or substrate or semiconductor or material\$1)) and ((non-porous\$2 or (non adj porous\$2) or impermeabl\$3 or porous-free or (free near2 porous\$2) or non-hole\$1 or (free near2 hole\$1) or non-bubbl\$3 or (free near2 bubbl\$3) or non-void\$1 or (void near2 free) or non-cavit\$3 or (free near2 cavit\$3) or non-vacanc\$3 or (free near2 vacanc\$3)) near15 (silicon or wafer\$1 or substrate or semiconductor or material\$1))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 18:27
-	7654	(convert\$3 or chang\$3 or produc\$4 or adapt\$3 or alter\$3 or renovat\$3 or switch\$3 or translat\$3 or form\$4) with ((porous\$2 or hole\$1 or bubbl\$3 or void\$1 or cavit\$3 or vacanc\$3 or permeabl\$3) near15 (silicon or wafer\$1 or substrate or semiconductor or material\$1)) with ((non-porous\$2 or (non adj porous\$2) or impermeabl\$3 or porous-free or (free near2 porous\$2) or non-hole\$1 or (free near2 hole\$1) or non-bubbl\$3 or (free near2 bubbl\$3) or non-void\$1 or (void near2 free) or non-cavit\$3 or (free near2 cavit\$3) or non-vacanc\$3 or (free near2 vacanc\$3)) near15 (silicon or wafer\$1 or substrate or semiconductor or material\$1))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 18:34

-	1185	<p>((convert\$3 or chang\$3 or produc\$4 or adapt\$3 or alter\$3 or renovat\$3 or switch\$3 or translat\$3 or form\$4) with ((porous\$2 or hole\$1 or bubbl\$3 or void\$1 or cavit\$3 or vacanc\$3 or permeabl\$3) near15 (silicon or wafer\$1 or substrate or semiconductor or material\$1)) with ((non-porous\$2 or (non adj porous\$2) or impermeabl\$3 or porous-free or (free near2 porous\$2) or non-hole\$1 or (free near2 hole\$1) or non-bubbl\$3 or (free near2 bubbl\$3) or non-void\$1 or (void near2 free) or non-cavit\$3 or (free near2 cavit\$3) or non-vacanc\$3 or (free near2 vacanc\$3)) near15 (silicon or wafer\$1 or substrate or semiconductor or material\$1))) and (((thick\$3 near10 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$3 or isolat\$3)) and (thin\$4 near10 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$3 or isolat\$3))) or ((multiple or differen\$3 or various or vary or varies or varying or two or second or another) near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) or ((first near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) and (second near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4))) or ((first near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) and ((second or another) near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4))) or ((first near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) with ((second or another) near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) with (thicker or thinner or thiner or greater or smaller or less or bigger or more)) or ((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4 or multiple) with (thickness\$2 or thick-ness\$2 or (thick adj ness))) or (first with second with (thickness\$2 or thick-ness\$2 or (thick adj ness\$2)) with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger)))</p>	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 18:36
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-	1297	((convert\$3 or chang\$3 or produc\$4 or adapt\$3 or alter\$3 or renovat\$3 or switch\$3 or translat\$3 or form\$4) with (non-porous\$2 or (non adj porous\$2) or impermeabl\$3 or porous-free or (free near2 porous\$2) or non-hole\$1 or (free near2 hole\$1) or non-bubbl\$3 or (free near2 bubbl\$3) or non-void\$1 or (void near2 free) or non-cavit\$3 or (free near2 cavit\$3) or non-vacanc\$3 or (free near2 vacanc\$3)) with (silicon or wafer\$1 or substrate or semiconductor or material\$1) with (porous\$2 or hole\$1 or bubbl\$3 or void\$1 or cavit\$3 or vacanc\$3 or permeabl\$3)) and (((thick\$3 near10 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$3 or isolat\$3)) and (thin\$4 near10 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$3 or isolat\$3))) or ((multiple or differen\$3 or various or vary or varies or varying or two or second or another) near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) or ((first near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) and (second near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4))) or ((first near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) and ((second or another) near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4))) or ((first near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) with ((second or another) near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) with (thicker or thinner or thiner or greater or smaller or less or bigger or more)) or ((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4 or multiple) with (thickness\$2 or thick-ness\$2 or (thick adj ness))) or (first with second with (thickness\$2 or thick-ness\$2 or (thick adj ness2)) with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger)))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 18:37
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-	130	(increas\$4 or boost\$4 or enlarg\$4 or rais\$4 or enhanc\$4 or high\$4 or bigger or great\$3) with (oxidiz\$8 or oxidat\$5) with (rates or rate or rat\$3) with ((porous\$2 or hole\$1 or bubbl\$3 or void\$1 or cavit\$3 or vacanc\$3 or permeabl\$3) near15 (silicon or wafer\$1 or substrate or semiconductor or material\$1))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 19:06
-	52	((increas\$4 or boost\$4 or enlarg\$4 or rais\$4 or enhanc\$4 or high\$4 or bigger or great\$3) with (oxidiz\$8 or oxidat\$5) with (rates or rate or rat\$3) with ((porous\$2 or hole\$1 or bubbl\$3 or void\$1 or cavit\$3 or vacanc\$3 or permeabl\$3) near15 (silicon or wafer\$1 or substrate or semiconductor or material\$1))) and (((thick\$3 near10 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$3 or isolat\$3)) and (thin\$4 near10 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$3 or isolat\$3))) or ((multiple or differen\$3 or various or vary or varies or varying or two or second or another) near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) or ((first near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) and (second near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4))) or ((first near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) and ((second or another) near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4))) or ((first near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) with ((second or another) near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) with (thicker or thinner or thiner or greater or smaller or less or bigger or more)) or ((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4 or multiple) with (thickness\$2 or thick-ness\$2 or (thick adj ness))) or (first with second with (thickness\$2 or thick-ness\$2 or (thick adj ness\$2)) with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger)))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 18:54
-	5	(increas\$4 or boost\$4 or enlarg\$4 or rais\$4 or enhanc\$4 or high\$4 or bigger or great\$3) with (oxidiz\$8 or oxidat\$5) with (rates or rate or rat\$3) with ((porous\$2 or hole\$1 or bubbl\$3 or void\$1 or cavit\$3 or vacanc\$3 or permeabl\$3) near15 (silicon or wafer\$1 or substrate or semiconductor or material\$1)) with ((non-porous\$2 or (non adj porous\$2) or impermeabl\$3 or porous-free or (free near2 porous\$2) or non-hole\$1 or (free near2 hole\$1) or non-bubbl\$3 or (free near2 bubbl\$3) or non-void\$1 or (void near2 free) or non-cavit\$3 or (free near2 cavit\$3) or non-vacanc\$3 or (free near2 vacanc\$3)) near15 (silicon or wafer\$1 or substrate or semiconductor or material\$1))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 19:01

-	36	(increas\$4 or boost\$4 or enlarg\$4 or rais\$4 or enhanc\$4 or high\$4 or bigger or great\$3) with (oxidiz\$8 or oxidat\$5) with ((porous\$2 or hole\$1 or bubbl\$3 or void\$1 or cavit\$3 or vacanc\$3 or permeabl\$3) near15 (silicon or wafer\$1 or substrate or semiconductor or material\$1)) with ((non-porous\$2 or (non adj porous\$2) or impermeabl\$3 or porous-free or (free near2 porous\$2) or non-hole\$1 or (free near2 hole\$1) or non-bubbl\$3 or (free near2 bubbl\$3) or non-void\$1 or (void near2 free) or non-cavit\$3 or (free near2 cavit\$3) or non-vacanc\$3 or (free near2 vacanc\$3)) near15 (silicon or wafer\$1 or substrate or semiconductor or material\$1))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 19:02
-	36	(increas\$4 or boost\$4 or enlarg\$4 or rais\$4 or enhanc\$4 or high\$4 or bigger or great\$3) with (oxidiz\$8 or oxidat\$5) with ((porous\$2 or hole\$1 or bubbl\$3 or void\$1 or cavit\$3 or vacanc\$3 or permeabl\$3) near15 (silicon or wafer\$1 or substrate or semiconductor or material\$1)) with ((non-porous\$2 or (non adj porous\$2) or impermeabl\$3 or porous-free or (free near2 porous\$2) or non-hole\$1 or (free near2 hole\$1) or non-bubbl\$3 or (free near2 bubbl\$3) or non-void\$1 or (void near2 free) or non-cavit\$3 or (free near2 cavit\$3) or non-vacanc\$3 or (free near2 vacanc\$3)) near15 (silicon or wafer\$1 or substrate or semiconductor or material\$1))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 19:07
-	1502	(increas\$4 or boost\$4 or enlarg\$4 or rais\$4 or enhanc\$4 or high\$4 or bigger or great\$3) with (oxidiz\$8 or oxidat\$5) with (((porous\$2 or hole\$1 or bubbl\$3 or void\$1 or cavit\$3 or vacanc\$3 or permeabl\$3) near15 (silicon or wafer\$1 or substrate or semiconductor or material\$1)) or ((non-porous\$2 or (non adj porous\$2) or impermeabl\$3 or porous-free or (free near2 porous\$2) or non-hole\$1 or (free near2 hole\$1) or non-bubbl\$3 or (free near2 bubbl\$3) or non-void\$1 or (void near2 free) or non-cavit\$3 or (free near2 cavit\$3) or non-vacanc\$3 or (free near2 vacanc\$3)) near15 (silicon or wafer\$1 or substrate or semiconductor or material\$1)))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 19:10

-	484	<p>((increas\$4 or boost\$4 or enlarg\$4 or rais\$4 or enhanc\$4 or high\$4 or bigger or great\$3) with (oxidiz\$8 or oxidat\$5) with ((porous\$2 or hole\$1 or bubbl\$3 or void\$1 or cavit\$3 or vacanc\$3 or permeabl\$3) near15 (silicon or wafer\$1 or substrate or semiconductor or material\$1)) or ((non-porous\$2 or (non adj porous\$2) or impermeabl\$3 or porous-free or (free near2 porous\$2) or non-hole\$1 or (free near2 hole\$1) or non-bubbl\$3 or (free near2 bubbl\$3) or non-void\$1 or (void near2 free) or non-cavit\$3 or (free near2 cavit\$3) or non-vacanc\$3 or (free near2 vacanc\$3)) near15 (silicon or wafer\$1 or substrate or semiconductor or material\$1)))) and (((thick\$3 near10 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$3 or isolat\$3)) and (thin\$4 near10 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$3 or isolat\$3))) or ((multiple or differen\$3 or various or vary or varies or varying or two or second or another) near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) or ((first near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) and (second near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4))) or ((first near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) and ((second or another) near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4))) or ((first near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) with ((second or another) near8 (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4 or isolat\$4)) with (thicker or thinner or thiner or greater or smaller or less or bigger or more)) or ((oxide\$1 or dioxide\$1 or dielectric or insulat\$4) with (varying or variable or varies or vary or differen\$4 or multiple) with (thickness\$2 or thick-ness\$2 or (thick adj ness))) or (first with second with (thickness\$2 or thick-ness\$2 or (thick adj ness\$2)) with (oxide\$1 or dioxide\$1 or dielectric\$1 or insulat\$4) with (smaller or thinner or thin\$4 or thick\$3 or greater or less or more or bigger)))</p>	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/31 19:10
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US-PAT-NO: 6013557

DOCUMENT-IDENTIFIER: US 6013557 A

TITLE: Advanced CMOS isolation utilizing
enhanced oxidation by
light ion implantation

----- KWIC -----

A method for forming field isolation regions in multilayer semiconductor devices comprises the steps of masking active regions of the substrate, forming porous silicon in the exposed field isolation regions, removing the mask and oxidizing the substrate. A light ion impurity implant is used to create pores in the substrate. Substrate oxidation proceeds by rapid thermal annealing because the increased surface area of the pores and the high reactivity of unsaturated bonds on these surfaces provides for enhanced oxidation.

The present invention is a simple, efficient method for forming field isolation regions in multilayer semiconductor devices. The method comprises the steps of masking active regions of the substrate, forming porous silicon in the exposed field isolation regions, removing the mask and oxidizing the substrate. To create pores in the substrate material, the substrate receives a heavy dose of a light ion impurity at a predetermined energy. Repeated implants of several light ion impurities at different energies can be used to create an implant zone of a predetermined depth in the field isolation regions. The invention permits the use of rapid thermal annealing to substantially

reduce oxidation times and encroachment. The invention also eliminates the need for chemical mechanical polishing or trench filling to improve surface planarity. To improve field oxide quality, the substrate may undergo a thermal anneal to densify the oxide layer following substrate oxidation. Similarly, subsequent processing may require removal or partial etching of the oxide layer formed over active regions during substrate oxidation. The oxide layer formed over active regions during substrate oxidation may serve additional device or processing functions. For example, this oxide layer may serve as a gate oxide layer or as a sacrificial oxide layer for a subsequent channel implant.

FIG. 1 is a cross sectional illustration of a semiconductor substrate prepared for the formation of porous silicon in the field isolation regions;

FIG. 2 is a cross sectional illustration of a semiconductor substrate after formation of porous silicon and removal of the mask;

FIG. 8 is a cross sectional illustration of the semiconductor substrate of FIG. 1 after formation of porous silicon followed by a trench etch;

FIG. 11 is a cross sectional illustration of a semiconductor substrate after formation of a buffer layer in preparation for formation of porous silicon in the field isolation regions;

FIG. 12 is a cross sectional illustration of a semiconductor substrate after formation of a buffer layer stack in preparation for formation of porous silicon in the field isolation regions;

FIG. 13 is a cross sectional illustration of the semiconductor substrate of

FIG. 11 after formation of porous silicon and removal of at least a portion of the buffer layer;

In one preferred embodiment, the semiconductor wafer 20 comprises a silicon substrate 22 masked with photoresist 24 over a substantially planar p-well 25 and n-well 23 structure. The substrate 22 receives a high dose Helium implant 28, typically 1×10^{17} ions/cm² at 20 keV, to form porous silicon in the field isolation regions 26.

To tailor surface topography of the substrate prior to oxidation, the field isolation method includes an etch following the light ion impurity implant. As shown in FIG. 5, a gas phase etch serves to remove some porous substrate material to thereby enlarge the pores 64 in the field isolation regions 62. In addition, the gas phase etch provides for stress relief during the subsequent oxidation. A wet etch can likewise remove porous substrate material to enlarge the pores 64 in the field isolation regions 62. In the preferred embodiment, porous silicon in the field isolation regions 62 undergoes a hydrogen down flow plasma etch inductively generated by an RF field of power between 20 watts and 100 watts, at a temperature between 400 deg C. and 600 deg C. and under a pressure of 15 mTorr for 5 minutes with the wafer 20 positioned between 20 cm and 40 cm downstream relative to the center of the plasma. In another preferred embodiment, a room temperature wet etch in 0.1% to 1.0% NH₄ OH water solution for 1 to 10 minutes serves to enlarge the pores 64. As discussed previously, the step of oxidizing the substrate follows the step of removing the mask from the active regions 66. In the preferred embodiment, silicon oxidation occurs by rapid thermal annealing of the

silicon wafer in a
dry O.sub.2 ambient at 1000 deg C. for about 5 minutes.

Referring now to FIG. 11, another preferred embodiment of the invention is illustrated wherein a semiconductor wafer 20 with an insulating buffer layer 124 is ready to receive a light ion impurity implant 128. Note that the buffer layer 124 may comprise a stack of multiple dielectrics. For example, FIG. 12 shows a buffer layer 131 having a **two level stack comprising silicon dioxide** 133 and silicon nitride 134. As with the embodiment described above, the substrate 22 of the embodiment in FIG. 11 has a mask 122 over its active regions 127 thereby exposing field isolation regions 125 for the light ion impurity implant. The substrate receives an implant of a heavy dose of a light ion impurity at a predetermined energy. In some cases, the substrate undergoes repeated implants of several light ion impurities at different energies to create an implant zone of a predetermined depth, typically 1500 Angstroms, in the field isolation regions. These light ion implants serve to create porous substrate material in the field isolation regions 125. The buffer layer 124 allows for optimization of the implant parameters to improve the depthwise uniformity of the porous substrate material.

In the preferred embodiment illustrated in FIG. 11, the semiconductor wafer 20 comprises a silicon substrate 22 having substantially planar p-well 25 and n-well 23 structures. An oxide buffer layer 124, typically 2000 Angstroms, is deposited over the wafer by a wet thermal oxidation at 1100 deg C. for 15 to 20 minutes. Similarly, as illustrated in FIG. 12, a buffer layer 131 having a **two level stack, for example, may be formed by growing oxide** of 200 Angstrom

thickness by thermal oxidation in O_2 at 900 deg C. for 5 minutes followed by deposition of a nitride layer of 1000 Angstrom thickness by chemical vapor deposition (CVD) using SiH_4 and NH_3 at a temperature between 400 deg C. and 600 deg C. for 60 minutes. Referring again to FIG. 11, a photoresist mask 122 with openings for the field isolation regions 125 is next patterned over the buffer layer 124. The silicon substrate receives a high dose Helium implant, typically 1×10^{17} ions/cm² at 40 keV, to form porous silicon in the field isolation regions 125.

As discussed previously, an etch of the porous field isolation regions 146 can be used to tailor the surface topography of the field isolation regions 146. A gas phase etch enlarges the pores 147 and provides for stress relief during subsequent oxidation. A wet etch can likewise enlarge the pores 147 in the field isolation regions 146. In the preferred embodiment, porous silicon in the field isolation regions 146 undergoes a hydrogen down flow plasma etch inductively generated by an RF field of power between 20 watts and 100 watts, at a temperature between 400 deg C. and 600 deg C. and under a pressure of 15 mTorr for 5 minutes with the wafer 20 positioned between 20 cm and 40 cm downstream relative to the center of the plasma. In another preferred embodiment, a room temperature wet etch in 0.1% to 1.0% NH_4OH water solution for 1 to 10 minutes serves to enlarge the pores 147. Similarly, a trench etch can be used to remove non-fully porous substrate material near the field isolation region surface. In the preferred embodiment, trenches are formed in the field isolation regions 146 by a CF_4 reactive ion etch (RIE) at room temperature, under 600 watts power and 200 mTorr

pressure for 4
seconds.

Although the disclosed invention can be generally used for device isolation functions, it can also be used to form trench structures. Here, the formation of porous silicon allows for enhanced etching and removal of material from the pores to form the trench structure. For example, the resulting trench structure can be used to form a capacitor.

forming porous silicon in said field isolation regions without anodization;

oxidizing both porous and non-porous regions of said silicon substrate after removing said mask.

2. The method of claim 1 wherein forming porous silicon in said field isolation regions comprises implanting an ion impurity formed from a noble gas.

8. The method of claim 1 further comprising recessing said porous silicon prior to oxidizing said silicon substrate.

forming porous silicon in said field isolation regions;

recessing said porous silicon; and

oxidizing said silicon substrate after recessing said porous silicon.

10. The method of claim 9 wherein forming porous silicon in said field isolation regions comprises implanting an ion impurity.

13. The method of claim 9 wherein recessing said porous silicon comprises applying a silicon wet etch.

14. The method of claim 9 wherein recessing said porous silicon comprises

applying a silicon gas phase etch.

16. The method of claim 9 wherein etching said porous silicon comprises applying an anisotropic etch to improve uniformity of said porous silicon.

forming porous silicon in said field isolation regions by implanting helium ions;

24. The method of claim 22 wherein forming porous silicon comprises repeated implanting of helium ions at different energies to create an implant zone of a selected depth within said silicon substrate prior to removing at least a portion of said buffer layer.

25. The method of claim 22 wherein, following removing said mask, the method further comprises recessing said porous silicon prior to oxidizing.

26. The method of claim 25 wherein recessing said porous silicon comprises applying a silicon wet etch.

27. The method of claim 25 wherein recessing said porous silicon comprises applying a silicon gas phase etch.

29. The method of claim 25 wherein recessing said porous silicon comprises applying an anisotropic etch to improve uniformity of said porous silicon.

US-PAT-NO: 4680963

DOCUMENT-IDENTIFIER: US 4680963 A

TITLE: Semiconductor flow velocity sensor

----- KWIC -----

When the semiconductor substrate is of silicon, the heat insulating means is preferably of an oxidized porous silicon layer. The oxidized porous silicon layer has a heat conductivity in the order of 1/50-1/100 times that of the silicon and may be formed into on the silicon semiconductor substrate to a thickness of 10 microns or more for a reduced period of time. Such an oxidized porous silicon layer serves as a very superior heat insulator.

Since the oxidized porous silicon layer also is superior in electrical insulation, it can reduce leakage of current from the heating unit to the semiconductor substrate to a very low level. Only by forming a protective layer of Si.sub.3 N.sub.4 or the like integrally on the surface of the semiconductor substrate comprising the heating unit and the peripheral sensor circuit as by sputtering, such a protective layer can efficiently insulate the heating unit particularly electrically, from a fluid to be measured. As a result, measurements can be carried out within the flow of an electrically conductive fluid.

In this illustrated embodiment, the thermal insulator 14 is formed by selectively processing a portion of the P-type silicon semiconductor substrate

10 into a porous area and then oxidizing the porous area to form an oxidized porous silicon layer.

The heating unit 12 is formed of non-porous N-type silicon layer located on the surface of the thermal insulator 14 at the center.

The oxidized porous silicon layer defining the thermal insulator 14 may be formed in accordance with one of the various well-known processes. It will now be described below.

In the sensor shown in FIGS. 1 and 2, an N-type area corresponding to the heating unit 12 is pre-formed on the surface of the P-type silicon semiconductor substrate 10 at the center. The semiconductor substrate 10 is then processed sufficiently to have a porous property and thereafter oxidized to form an oxidized porous silicon layer or thermal insulator 14 of a desired thickness between the heating unit 12 and the silicon semiconductor substrate 10.

To this end, a portion of the semiconductor substrate 10 having a square-shaped surface is processed to be porous. The processed portion is oxidized to form an oxidized porous silicon layer used as a thermal insulator 14, as in the first embodiment. Then a portion of the semiconductor substrate under the oxidized porous silicon layer is etched from the bottom to form a substantially square sheet-shaped portion 30 including the thermal insulator 14. An N-type silicon resistor functioning as the heating unit 12 is pre-formed on the surface of the sheet substrate portion 30 at the center as in the first embodiment. The area other than the N-type silicon resistor is formed as the thermal insulator 14.

Since the sensor of the second embodiment is superior in heat shielding property, it can have sufficient thermal insulation even if a non-porous P-type silicon 36 is left below the heating unit 12 as shown in FIG. 5 or even if the porous silicon oxide layer has a thickness smaller than that of the first embodiment.

a thermal insulation means which is formed by selectively making a portion of said semiconductor substrate porous and oxidizing said portion to form an oxidized porous silicon layer in such a manner that the surface of said thermal insulation means is exposed substantially flush with the surface of said semiconductor substrate;

2. A semiconductor flow velocity sensor as defined in claim 1 wherein said semiconductor substrate is formed of one selected from P- and N-type silicon and wherein said thermal insulation means is formed of an oxidized porous silicon layer.

4. A semiconductor flow velocity sensor as defined in claim 2 wherein said thermal insulation means is formed by selectively processing a portion of a silicon semiconductor substrate to make said portion porous and then oxidizing said portion to form an oxidized porous silicon layer thereon and wherein said heating unit is formed by leaving a portion of said substrate within said thermal insulation means.